

1	GENERAL												
2	Project:	INSTALLATION OF GTC AT GANDHAR						Job No.:	B240				
3	Owner:	GAIL (INDIA) LTD.						Site:	GPU GANDHAR				
4	Purchaser:							Unit:	NEW COMPRESSOR AREA		Unit No.: 910		
5	Item No.:	910-K-901						Service:	NATURAL GAS COMPRESSOR				
6	No. of Units:	ONE	Working:	ONE	Standby:	NONE	Driver:	Working:	GAS TURBINE	Standby:	NONE		
7	Applicable to:	☒ Proposal		☐ Purchase				☐ As Built					
8	☒ : Scope, Option & Information specified by Purchaser. ☐ : Information reqd from and options left to vendor. Vendor to cross(☒) the selected Option.												
9	Manufacturer:	☐ Model		Driver Type:		☐ Elec. Motor ☒ GT ☐ ST							
10	Place of Mfrg.:	Drive Arrgmt.		☐ Direct ☒ Thru' gear box									
11	Duty:	☒ Continuous		☐ Intermittent		☐ Standby							
12	No. of stages: 01 (One) (Note-4)												
13	OPERATING CONDITIONS (Note-21)												
14	(ALL DATA ON PER UNIT BASIS)			Case-1A				Case-1B		Case-2A			
15		Case-1A1	Case-1A2	Case-1A3	Case-1A4	Case-1B1	Case-1B2	Case-2A1	Case-2A2	Case-2A3	Case-2A4		
16													
17	☒ Gas Handled (Also see Page 2 of 7)												
18	☐ Nm ³ /Hr (1.033 Kg/cm ² A, 0 °C Wet)												
19	☒ Weight Flow, kg/hr (Dry) (Note-1)	110021	110021	110021	110021	110021	110021	----	----	----	----		
20	☒ Weight Flow, kg/hr (Wet) (Note-1)	----	----	----	----	----	----	123044	123264	123009	123204		
21	Inlet Conditions: @ Compr. Suc. Flange												
22	☒ Pressure (kg/cm ² G) (Note-2)	36	36	39	39	33	33	25	25	28	28		
23	☒ Temperature (°C)	45	55	45	55	40	50	40	50	40	50		
24	☐ Relative Humidity (%)												
25	☒ Avg. Molecular Weight (Dry basis)	17.8811	17.8811	17.8811	17.8811	17.8811	17.8811	----	----	----	----		
26	☒ Avg. Molecular Weight (Wet basis)	----	----	----	----	----	----	19.9163	19.9163	19.9163	19.9163		
27	☒ C _p / C _v (K ₁) or (K _{Avg}) (Note-23)	1.3893	1.3731	1.3994	1.382	1.3875	1.3717	1.3421	1.328	1.3539	1.3383		
28	☒ Compressibility (Z ₁) or (Z _{Avg})	0.9284	0.936	0.9231	0.9313	0.9299	0.9374	0.9321	0.9393	0.9246	0.9326		
29	☐ Inlet Volume, (m ³ /hr) (Wet / Dry)												
30	☐ Inlet Volume, (m ³ /hr) (Wet / Dry)												
31	Discharge Conditions: @ Compr. Dis. Flange												
32	☒ Pressure (kg/cm ² G) (Note-3)	92	92	92	92	92	92	92	92	92	92		
33	☒ Temperature (°C) (Estimated/Actual) (Note-4)												
34	☐ C _p / C _v (K ₁) or (K _{Avg})												
35	☐ Compressibility (Z ₁) or (Z _{Avg})												
36	Performance:												
37	☐ BkW Required (All losses Incl)												
38	☐ Mech. & Seal Losses Included in BkW												
39	☐ Speed (rpm)												
40	☐ Estimated Surge m ³ /hr (At above speed)												
41	☐ Polytropic Head (m)												
42	☐ Polytropic Efficiency (%)												
43	☒ Certified/Guarantee Point	----	----	----	----	----	YES	----	----	----	----		
44	☐ Performance Curve Number												
45	Process Control Method												
46	☐ Suction Throttling From (kg/cm ² A) To (kg/cm ² A). (If required/ recommended)												
47	☐ Variable Inlet Guide Vanes												
48	☒ Speed Variation From % To %.												
49	☐ Discharge Blow off To												
50	☒ Cooled Bypass From Discharge To Suction through Anti-Surge Valve												
51	Signal ☒ Source: (Refer Process P&ID)												
52	Type ☐ Electronic Manual from ☐ DCS ☐ Pneumatic ☒ Other : Master Controller												
53	Range mA (Kg/cm ² A).												
54	Antisurge Bypass (Refer Job specification/P&IDs) ☒ Manual ☒ Automatic ☐ None												
55	REMARKS:												
56													
57													
58													
59													
60													
61													

OPERATING CONDITIONS (Continued)									
Gas analysis		Case-1A	Case-1B	Case-2A	REMARKS				
■ Mol % (Wet Basis)									
62									
63									
64									
65									
66	Constituent	MW			Upstream Design Pressure kg/cm ² g				
67	Air	28.966			Upstream Design Temperature °C				
68	Oxygen	32.000			Downstream Design Pressure kg/cm ² g				
69	Nitrogen	28.016	0.23	0.23	0.16	Downstream Design Temperature °C			
70	Water	18.016			Fully Sat.	Note-5			
71	CO	28.010				(*) To be confirmed by vendor based on settle-out pressure. Also refer Note-10.			
72	CO ₂	44.010	2.36	2.36	2.47				
73	H ₂ S	34.076	0.00141	0.00141	0.00141				
74	Hydrogen	2.016							
75	Methane	16.042	90.35	90.35	85.73				
76	Ethylene	28.052							
77	Ethane	30.068	5.93	5.93	5.06				
78	Propylene	42.078							
79	Propane	44.094	1.06	1.06	3.74				
80	i-butane	58.120							
81	n-butane	58.120	0.05	0.05	1.79				
82	i-pentane	72.146							
83	n-pentane	72.146			0.56				
84	n-Hexane								
85	C6+				0.48				
86	Pentylene								
87	Total								
88	Avg. Mol. Wt.		17.88	17.88	19.9163				
89	Dew point (°C)		(-)103	(-)103	(-)35				
90	Location:				Noise specifications:				
91	■ Indoor	☐ Outdoor	■ Grade	■ Applicable to Machine: Max. 85 dBA @ 1 m.					
92	☐ Heated	■ Under-roof	☐ Mezzanine	See Specification					
93	■ Un-heated	■ Partial Sides	☐	■ Applicable to Neighborhood: Max. dBA @ m.					
94	■ Elect. Area Classification (Note-6)			See Specification					
95	☐ Winterization Req'd (2.1.8) ■ Tropicalization Req'd.			■ Acoustic Housing ☐ Yes (If Req'd) ■ No					
96	Site data: (Note 7)			Applicable specifications:					
97	☐ Elevation (m):		☐ Barometer (kg/cm ² A):		■ API Std. 617, 7 th edn. July 2002.				
98	☐ Range of Ambient Temps.		Dry Bulb	Wet Bulb	■ Vendor having Unit Responsibility: SPRV Vendor				
99	Normal (°C):				■ Governing Specification: Job spec. No. B240-910-80-42-SP-5010				
100	Max. (°C):				Painting:				
101	Min. (°C):				■ Manufacturer's Standard				
102	Site Rated(°C):				☐ Other				
103	Unusual conditions:			Shipment:					
104	■ Dust ■ Fumes				☐ Domestic ■ Export ■ Export Boxing Req'd				
105	☐ Others :				■ Outdoor Storage More than 12 Months				
106					■ Spare Rotor assembly packaged for:				
107					☐ Horizontal Storage ■ Vertical Storage				
108	REMARKS:								
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CONSTRUCTION FEATURES			
124			
125	■ Speeds: [As per API 617]		Type (Open, Enclosed etc.): Enclosed
126	Max. Continuous:	RPM Trip: RPM	Type Fabrication:
127	Max. Tip Speeds @ Rated Speed (100% speed):	Material:	
128	Max. Tip Speed @ Max. Continuous Speed:	Max. Yield Strength (Kg/cm ²):	
129			Brinell Hardness: Max.: Min.:
130	■ Lateral Critical Speeds (Damped): [As per API 617]		Smallest Tip Internal Width (mm):
131	First Critical	RPM Mode	Max. MACH Number @ Impeller Eye:
132	Second Critical	RPM Mode	Max. Impeller Head @ Rated Speed (m):
133	Third Critical	RPM Mode	■ Shaft:
134	Fourth Critical	RPM Mode	Material:
135			Dia @ Impeller (mm): Dia @ Coupling (mm):
136	■ Compressor Lateral Analysis Required		Shaft End: ☐ Tapered ☐ Cylindrical
137	■ Train Torsional Analysis Required		Max. Yield Strength (Kg/cm ²):
138	(Turbine Driven Train)		Shaft Hardness (BHN) (R _c):
139	■ Torsional Critical Speeds: [As per API 617]		Max. Torque Capability (kgm):
140	First Critical	RPM	☐ Balance Piston:
141	Second Critical	RPM	Material: Area (mm ²):
142	Third Critical	RPM	Fixation Method:
143	Fourth Critical	RPM	■ Shaft Sleeves:
144	■ Vibration: Allowable Test Level (Peak To Peak) (mm):		At Intstg. Close Clearance Points: Material: Stainless Steel
145	(including electrical & Mechanical Run-out)		At Shaft Seals: Material: Stainless Steel
146	☐ Rotation Viewed From Driven End: ☐ CW ☐ CCW		☐ Accessible
147	■ Materials Inspection Requirements		■ Labyrinths:
148	☐ Special Charpy Testing		Interstage: Type: Material: Aluminum Alloy or SS
149	■ Radiography Required for Casing and welds (100%)		Balance piston: Type: Material: Aluminum Alloy or SS
150	■ Ultrasonic Required for Shaft, Major Forging		
151	■ Magnetic Particle Required for Impellers		■ Shaft seals: (Note-8 & 9)
152	■ Liquid Penetrant Required for Impellers		■ Seal Type: Dry gas seal (Tandem with internal labyrinth)
153	■ Casing:		■ Settling Out Pressure (Kg/cm ² G): (Note-10)
154	Model:		☐ Special Operation:
155	Casing Split: Horizontally split		☐ Supplemental Device Required for Contact Seals:
156	Material: CS		Type:
157	Thickness (mm):	Corrosion Allowance(mm): 3.2	■ Buffer Gas System Required: ☐ Manifold
158	Max. Working Pressure (Kg/cm ² G):		■ Buffer Gas Type: Primary: (Note-8 & 9) Secondary: (Note-8 & 9)
159	Max. Desig Pressure (Kg/cm ² G): ≥92		■ Buffer Gas Control System (Schematic by vendor):
160	Test Pressure (Kg/cm ² G): Helium: Hydro: 1.5xDesgn.Pr. Or More		☐ Pressurising Gas for Subatmospheric Seals:
161	Max. Operating Temp. (°C):	Min. Operating Temp (°C):	■ Type Seal: Tandem (Refer Job specification)
162	Max. No. of Impellers For Casing:		☐ Inner Oil Leakage (Guaranteed)(m ³ /day/seal):
163	Max. Casing Capacity (m ³ /hr):		Buffer Gas Required for:
164	Radiograph Quality:	■ Yes ☐ No	☐ Air Run In ☐ Other
165	Casing Split Sealing:		☐ Buffer Gas Flow (Per Seal): ■ Separation Gas : Instrument Air
166	■ System Relief Valve Set Point (Kg/cm ² G): 92.0		Norm.: Kg/min @ Kg/cm ² ; Diff. Pr.:
167	■ Diaphragms:		Max.: Kg/min @ Kg/cm ² ; Diff. Pr.:
168	Material:		
169	■ Impellers:		☐ Bearing housing construction:
170	No.:	Diameters:	Type (Separate/Integral) : Split: Horizontal
171	No. Vanes EA. Impeller:		Material:
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174	REMARKS:		
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UTILITIES										
308	Utility conditions: (Note-7)					Total utility consumption: (Note-15)				
309	Steam	Drivers	Heating			Cooling Water:		m ³ /hr		
310	Inlet: Min.	kg/cm ² G	°C.	kg/cm ² G	°C.	Steam Normal:		Kg/hr		
311	Nor.	kg/cm ² G	°C.	kg/cm ² G	°C.	Steam Maximum:		Kg/hr		
312	Max.	kg/cm ² G	°C.	kg/cm ² G	°C.	Instrument Air:		Nm ³ /hr		
313	Exhaust: Min.	kg/cm ² G	°C.	kg/cm ² G	°C.	HP (Driver):		KW		
314	Nor.	kg/cm ² G	°C.	kg/cm ² G	°C.	HP (Auxiliaries):		kW		
315	Max.	kg/cm ² G	°C.	kg/cm ² G	°C.	Heaters:		kW		
316	Electricity: (Note-6)					Purge (Air or N ₂)		Nm ³ /hr		
317	Drivers	Heating	Control	Shutdown		Miscellaneous:				
318	Voltage					☒ Recommended Straight Run of Pipe Diameters				
319	Hertz					Before Suction:				
320	Phase					☐ Nomographs Reqd. for each Section				
321	Cooling Water: (Not available)					☒ Vendor's Review & Comments on Purch. Piping & Foundation				
322	Temp. Inlet:	°C.	Max. Return:	°C.		☐ Compressor to be suitable for Field Run in on Air				
323	Press. Norm.:	kg/cm ² G.	Design:	kg/cm ² G.		☐ Provision for Liquid Injection				
324	Min. Return:	kg/cm ² G.	Max. Allow.)P:	kg/cm ² .		☒ Vendor's Review & Comments on Purch. Control System				
325	Water Source:	Fouling Factor:				☒ Extent of Process Piping By Vendor as per Job Spec.				
326	Instrument air: (Note-6)					☐ Shop Fit Up of Vendor Process Piping				
327	Max. Press.	kg/cm ² G.	Min. Press.:	kg/cm ² G.		☐ Welding Hardness Testing				
328						☒ Aux. Eqpt. Monitors Explosion Proof (Note-6)				
329	SHOP INSPECTION & TESTS					☒ Provide spare rotor for each Compressor Casing				
330		Reqd.	Withn.	Obs.		☒ Optical Alignment flats reqd. for compressor & driver				
331	Shop Inspection	☒	☐	☐		Vendor's Representative shall				
332	Cleanliness	☒	☐	☐		☐ Observe Flange Parting				
333	Hydrostatic	☒	☒	☐		☒ Check Alignment at Temperature				
334	Impeller Overspeed	☒	☒	☐		☒ Be Present at Initial Alignment				
335	Mechanical Run (main & spare rotor)	☒	☒	☐		☐ Weights (kg):				
336	☒ Contract Coupling	☐ Idling Adaptor(s)				Compr.:	Gear:	Driver:	Base:	
337	☒ Contract Probe	☐ Shop Probes				Rotors:	Compr:	Driver:	Gear:	
338	Vary LO Pres. & Temp.	☒	☒	☐		Compr. Upper Case:				
339	Polar Form Vib Data	☒	☐	☐		Sour Seal Oil Traps:				
340	Tape Record Vib Data	☒	☐	☐		LO Console:	SO Console:			
341	Tape Data To Purch.	☒	☐	☐		Overhead Seal Oil Tanks:				
342	Shaft End Seal Insp.	☒	☒	☐		Max. Wt. For Maintenance:	(Pl. Identify)			
343	Gas Leak test Disch. Pressure	☒	☒	☐		Total Shipping Weight:				
344	☐ Before	☒ After Post Test Inspection				☐ Space requirements (m):				
345	Performance Test (Gas/Air) (Note-24)	☒	☒	☐		Complete Unit:	L:	W:	H:	
346	Complete Unit Test	☐	☐	☐		LO Console:	L:	W:	H:	
347	Torsional vib Measurement	☐	☐	☐		SO Console:	L:	W:	H:	
348	Tandem Test	☐	☐	☐		Sour SO Traps:				
349	Seal Leakage Performance Test (\$)	☒	☒	☐		Ovhd. Seal Oil Tanks:				
350	Dynamic Balancing of Rotor	☒	☐	☒		\$:At Seal Vendor's works				
351	Helium Leak Test	☐	☐	☐						
352	Sound Level test	☒	☒	☐						
353	Full Load/Speed/Pressure Test	☐	☐	☐						
354	Shop Verification of Unbalanced Response Analysis	☒	☒	☐						
355	Certif. Copies Of Test Data & Matrils	☒	☐	☐						
356	Residual Elect. & Mech. Run Out	☒	☒	☐						
357	Check Bearings & Seals after Test	☒	☒	☐						
358	Rotor insensitivity test	☒	☒	☐						
359	Dis-assemble & Re-assemble after Test	☒	☒	☐						
360	Gear Unit Tests (Refer Gear Unit Data sheet)	☒	☐	☐						
361	REMARKS:									
362										
363										

364	Notes:														
365	1. Capacity indicated is rated capacity of the compressor i.e. corresponding to 3.5 MMSCMD.														
366	2. Suction Pressure indicated is at the Suction flange of the Compressor. Temporary Strainer shall be in suction line during start-up and same shall be replaced by permanent "T" type strainer subsequently. Pressure drop of 0.1 kg/cm2 has been considered to arrive at the Compressor suction pressure. In case the pressure drop is more than the above value, vendor to indicate the pressure drop and re-calculate the value of suction pressure at compressor flange. The revised value of suction pressure shall be indicated in the Compressor datasheet and shall be the basis of Compressor of selection and sizing of the Compressor. Bidder shall provide the mesh size and the pressure drop across the permanent strainer in his bid/offer.														
367	3. Discharge pressure indicated is at the compressor discharge flange.														
368	4. Compressor is envisaged to be of SINGLE STAGE. The expected/actual discharge temperatures at the compressor discharge shall be indicated and by the bidder. However, the discharge temperature should not cross 180°C under any circumstances.														
369	5. The design temperature at the compressor discharge shall be confirmed by the bidder.														
370	6. Refer Electrical specifications forming part of inquiry document.														
371	7. Refer site and utility data Doc. No. B240-910-80-42-SU-5010 Rev. A														
372	8. Normal/Emergency gas supply shall be taken from Compressor discharge as shown in P&ID No. B240-02-42-910-1111.														
373	9. The composition, avg. MW and dew-point of the normal/emergency/start-up seal gas in case of each individual case shall be as indicated in Page 2 of 10 of this datasheet. The Battery-limit (B/L)conditions of normal/emergency seal gas shall be as noted below: <table><tr><th>Details</th><th>B/L Pressure (kg/cm2G)</th><th>B/L Temperature (°C)</th></tr><tr><td>Normal Seal Gas</td><td>92 (\$)</td><td>(#)</td></tr><tr><td>Emergency Seal Gas</td><td>60 to 92 kg/cm2G (\$)</td><td>(#)</td></tr><tr><td>Start-up Seal Gas</td><td>(\$)</td><td></td></tr></table> (\$) Any pressure-let down (or boosting) device required shall form part of bidder's scope of supply. (#)The B/L temperature shall be the discharge temperature (at compressor discharge) as confirmed by bidder inline with note-4. Seal gas cooler (Air-cooled type) shall be included in the bidder's scope of supply. Vendor shall provide necessary filter, electric heater, pressure regulator, control valves etc. for seal gas system. For more details, please refer Job specification.			Details	B/L Pressure (kg/cm2G)	B/L Temperature (°C)	Normal Seal Gas	92 (\$)	(#)	Emergency Seal Gas	60 to 92 kg/cm2G (\$)	(#)	Start-up Seal Gas	(\$)	
Details	B/L Pressure (kg/cm2G)	B/L Temperature (°C)													
Normal Seal Gas	92 (\$)	(#)													
Emergency Seal Gas	60 to 92 kg/cm2G (\$)	(#)													
Start-up Seal Gas	(\$)														
374	10. The settle-out pressure value indicated is in ON HOLD. Compressor vendor shall furnish Settle-out Pressure calculations and Blow-down calculations for review by the Purchaser during Detailed engineering.														
375	11. The make and model of bearing temperature monitoring system, vibration and axial displacement monitoring system shall be as per Instrumentation specification forming part of inquiry document.														
376	12. The location of bearing temperature monitoring system, vibration and axial displacement monitoring system shall be as per Instrumentation specification forming part of inquiry document.														
377	13. The flange rating indicated is minimum required. The same shall be confirmed by the bidder in his bid/proposal.														
378	14. The compressor shall be designed to withstand external forces and moments on each nozzles based on 1.85 times NEMA SM-23 values or values calculated as per Annexure 2E of API Std. 617, 7 th edition, whichever is higher.														
379	15. Vendor shall furnish all utilities required for the complete package in a consolidated single document.														
380	16. Vendor shall provide the performance curves for all cases of operation.														
381	17. Vendor shall include in his scope of supply all normal instrumentation and control (including anti-surge control)/all essential auxiliaries for efficient operation, shutdown and safety requirements.														
382	18. Apart from the vendors scope of supply as per P&ID no. B240-02-42-910-1112 & 1113, vendor shall supply additional instrumentation, control & shutdown logic devices for safe and efficient operation of machine.														
383	19. Automatic spill back is considered for compressor.														
384	20. Compressor will start from control panel located in main control room, however, start clearance from field will be provided. Monitoring & control of the compressor station shall be performed from DCS/PLC.														
385	21. CASE-1: represents while GANDHAR GPU is running condition (normal operating case). CASE-2: represents while GANDHAR GPU is stopped condition. Compressor shall be running under case-i for most of the time.														
386	22. Vendor to provide max. Rate of depressurisation during compressor trip/esd.														
387	23. Cp/ Cv value is estimated for calculation purpose, Cp/ Cv value shall be confirmed by vendor.														
388	24. Performance Test for Compressor shall be done as per Type 2 ASME PTC- 10-1997 at Compressor Manufacturer's Works.														

16.04.2019	A	AS	NK
DATE	REV	JOB ENGINEER	REV & APPROVED BY